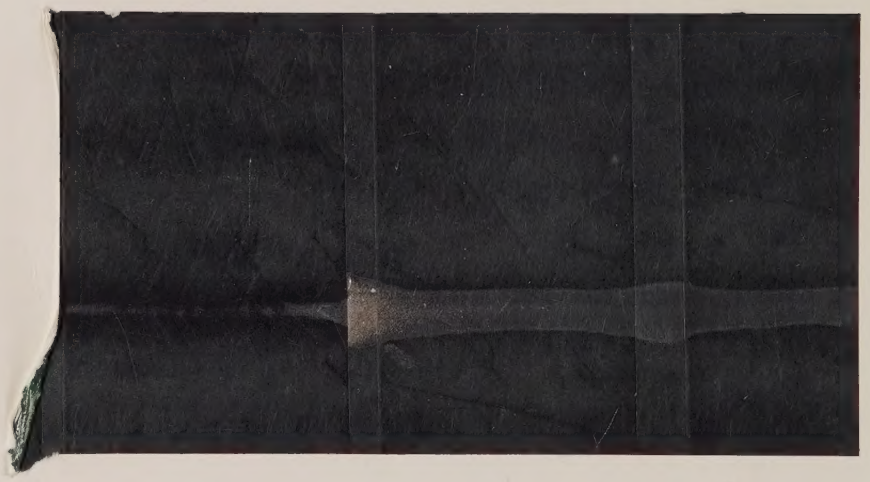
BOONTON ELECTRONICS CORPORATION

Instruction Manual

Model 93AD

True RMS Voltmeter



Instruction Manual

Model 93AD

True RMS Voltmeter

93AD
b-872

BOONTON ELECTRONICS CORPORATION

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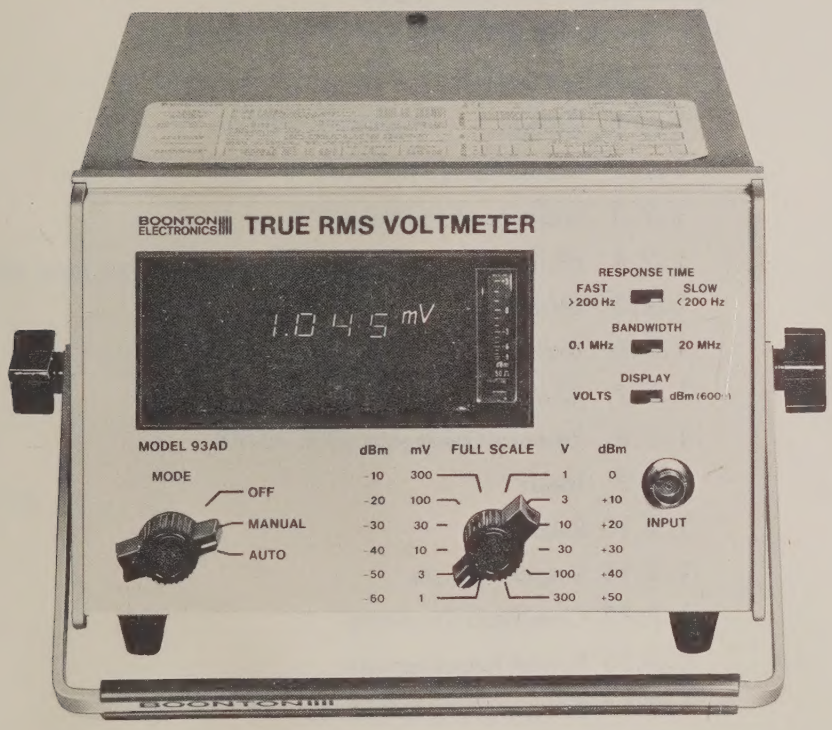

Model 93AD

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CHAPTER I

EQUIPMENT DESCRIPTION

1.1 INTRODUCTION

The Model 93AD furnishes true rms voltage measurements of sine, complex, pulse and random waveforms over a voltage range of 300 μV to 300 V, and a frequency range of 10 Hz to 20 MHz. With the dBm options, the overall range is -68 to +60 dBm. The exact dBm range will depend upon the option chosen.

The digital display uses Light-Emitting Diodes for clear, unambiguous readings. A small edge meter, calibrated in dB over a 12 dB range, is mounted beside the digital display. While this is useful for comparative dB readings, its major usefulness is for peaking or nulling indications, an application for which a digital display is usually found confusing. The LED display offers, in addition to the 3-digits-plus-1 voltage readout, decimal point, over- and under-range indicators, mode (volts or dBm) and polarity (for dBm option instruments).

The Model 93AD is designed for easy integration into external test systems; full BCD output (8,4,2,1), using standard positive logic, TTL compatible, is supplied as standard. In addition to the BCD outputs, an analog output is furnished, supplying up to 10 volts dc for full-scale reading on each range with a linearity of ±0.3% of fs and a source resistance of ≅ 5 Ω. Command inputs are provided for remote control of all essential functions.

Bandwidth and response time of the instrument are both selectable, by panel switches and remotely, to suit the measurement requirements. The input impedance of the 93AD as supplied is 2 MΩ in parallel with 25 pF or less; a high-impedance probe (Model 93-1A) is available as an optional accessory. This probe has an input impedance of 10 MΩ in parallel with 11.5 pF or less. The signal-input BNC connector, normally mounted on the front panel, may be mounted on the rear panel as an option (Model 93AD-08) to fit a particular installation. Autoranging (Model 93AD-01) is another optional feature.

The Model 93AD is of completely solid-state design, including the chopper; this contributes to the reliability, stability, light weight and compact size of the instruments. The chopper operates at 94 Hz, reducing the susceptibility to line-frequency-related fields and enhancing the low-noise quality of this design.

The mechanical design of the 93AD is simple and rugged, with easy access provided to all components. The extensive use of plug-in printed circuit board construction makes maintenance and adjustment relatively simple procedures. The sturdy bail provided serves as a comfortable carrying handle for the instrument, and as an adjustable mounting foot to tilt the case for easy viewing when it is at bench level.

Packaged in a compact half-rack case, the 93AD may be rack-mounted, singly or in pairs, with an optional rack-mounting kit Model 92-1A or 92-1B.

1.2 SPECIFICATIONS

1.2.1 Range

	Voltage fs	*dBm 1 mW, 600 Ω
1-	300 V	+50
2-	100 V	+40
3-	30 V	+30
4-	10 V	+20
5-	3 V	+10
6-	1 V	0
7-	300 mV	-10
8-	100 mV	-20
9-	30 mV	-30
10-	10 mV	-40
11-	3 mV	-50
12-	1 mV	-60

*with dBm option instruments

Lowest calibrated voltage level = 300 μV

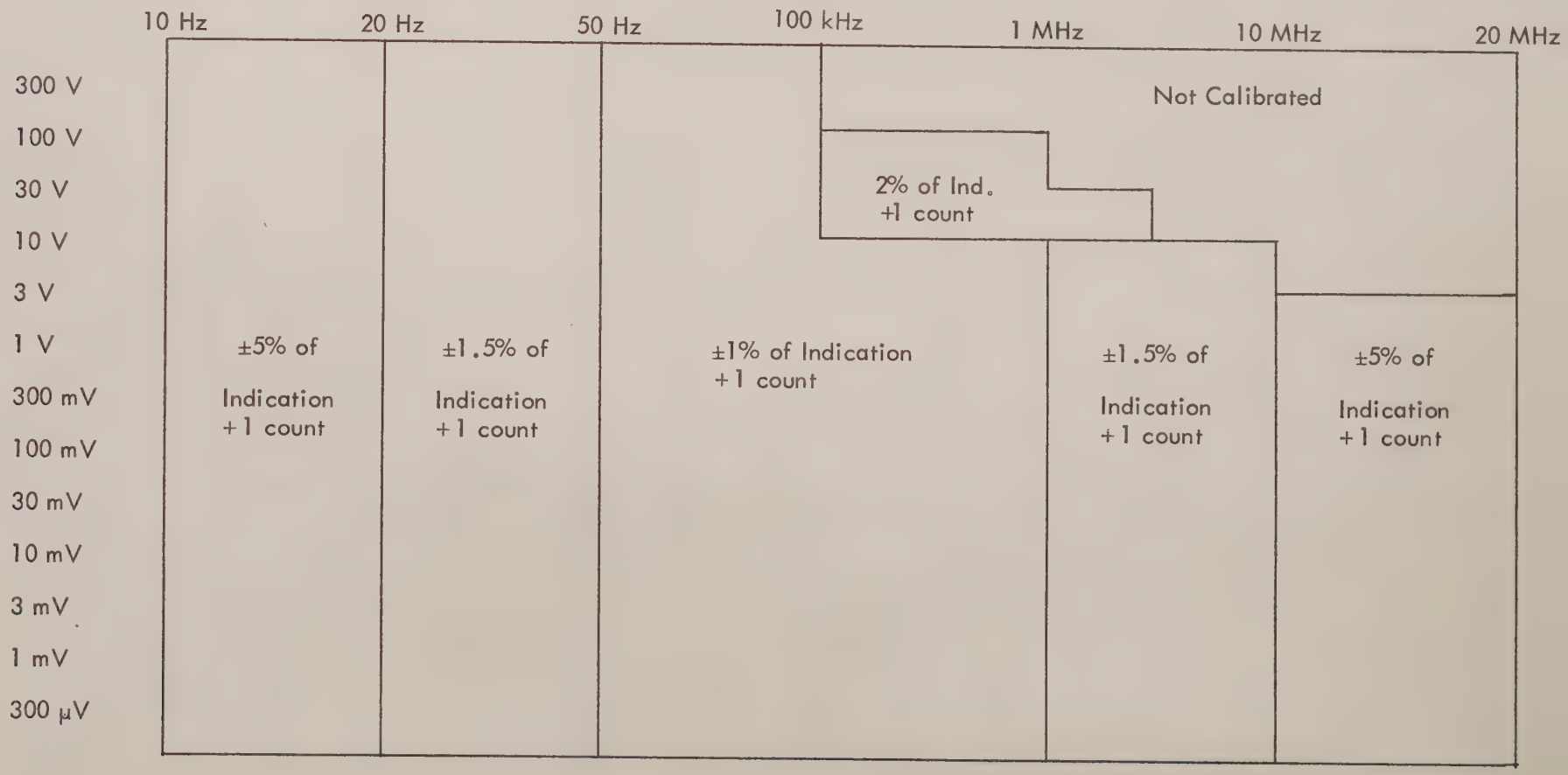
Lowest displayed voltage level ≅ 250 μV

1.2.2 Bandwidths

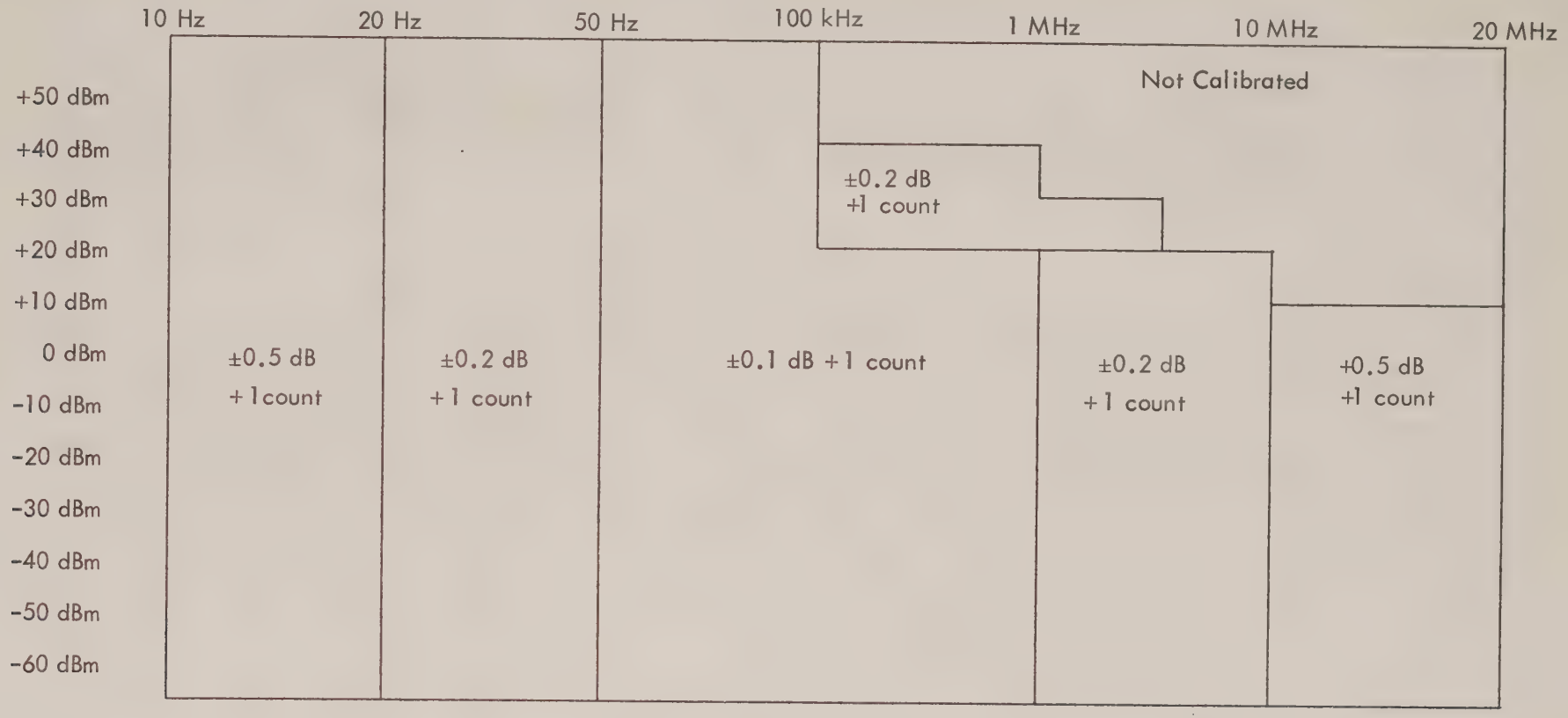
10 Hz to 20 MHz

10 Hz to 100 kHz

1.2.3 Voltage Accuracy



1.2.4 dBm Accuracy (For Model 93AD-10 and 93AD-15 Instruments)



1.2.5 Stability

Reference conditions:

Line voltage:	115 V, ±2%
Line Frequency:	50 Hz - 400 Hz
Warmup period:	1 hour
Temperature	21°C to 25°C

Warmup time: Useable after 2 minutes; 0.3% drift after 1 hour.

Effect of ±10% line voltage change: ≤ 0.2% of indication

Effect of ±10% line frequency change: ≤ 0.2% of indication

1.2.6 Indicators

Digital	LED type, 3 digits +1, decimal point, units (V, mV, dB), underrange, overrange,and polarity for dBm.
Analog:	Edge meter, calibrated over 12 dBm range.

1.2.7 Outputs

A: At 44-pin edge connector, rear mounted.

Range:	4 lines, 8, 4, 2, 1
Display:	4 lines, 8, 4, 2, 1
	4 lines, digit indicator (1, 2, 3, 4)
Overrange:	1 line
Underrange:	1 line
V mode:	1 line
Analog out:	1 line
-dBm:	1 line
Encode complete:	1 line
Logic levels:	1 = 2.4 V to 5.5 V
	0 = ≤ 0.7 V

B: At rear-panel binding posts:

Low terminal:	Case ground
High terminal:	DC Analog output:
Amplitude:	+10 V fs on "1" ranges; +9.5 V fs on "3" ranges.
Function:	Linear function of input voltage over 10 dB range from full scale.
Accuracy:	±0.25% rdg ±0.3% fs relative to meter indication.
Source Resistance:	≅5 ohms; max. loading 1 mA at fs for specified accuracy.

1.2.8 Remote Control

(At 44-pin edge connector on rear panel)

Manual disable:	1 line
Range enable:	12 lines
dB enable:	1 line
Auto enable:	1 line
Response time:	1 line
Bandwidth:	1 line
Encode hold:	1 line
Encode trigger:*	1 line

Above commanded with logic low (0 to 0.7 V) referred to ground.

*Encode interval triggered by logic low pulse, with pulse width between 0.25 and 1.0 μsec.

1.2.9 Input

Connector:	BNC type, signal low at case ground.
Impedance:	2 MΩ, ≤ 25 pF.
Equivalent noise:	< 30 μV.
Swinging:	(60 Hz, 120 Hz, 180 Hz) ≤ ±0.5% fs; ≤ ± 1.0% at 1/3 scale.

1.2.10 Response

Type:	rms, calibrated in rms.
Crest factor:	6 at full scale; 18 at 1/3 scale.
Waveform:	Sine, complex, pulse or random.

1.2.11 Response Time

Response Time	*Up Scale	*Down Scale
Fast > 200 Hz	1 sec.	2 sec.
Slow < 200 Hz	4 sec.	6 sec.

*Time to arrive within specified accuracy after application of step function of signal, measured at analog dc out.

1.2.12 Overload Recovery

Response Time	Overload at fs	Time*
Fast (> 200 Hz)	20 dB	1 sec.
"	40 dB	4 sec.
"	60 dB	6 sec.
"	80 dB	6 sec.
"	100 dB	6 sec.
Slow (< 200 Hz)	20 dB	2 sec.
"	40 dB	4 sec.
"	60 dB	6 sec.
"	80 dB	7 sec.
"	100 dB	7 sec.

*To within ±1% of final indication

1.2.13 Power Requirements

115 or 230 volts ±10%, 50 to 400 Hz.

1.2.14 Temperature Influence

Temperature Range		Influence
Reference	21°C to 25°C	0
Normal	18°C to 30°C	0.01%/°C of Indication
Severe	0°C to 50°C	0.02%/°C of Indication

1.2.15 Dimensions

5.2" high (without rubber feet), 8.3" wide, 12.5" deep (132 x 211 x 318 mm)

1.2.16 Weight

9.75 lbs. net (4.42 kg)

1.2.17 Options and Accessories

Model 93AD-01	Autoranging. Automatically selects correct range for the voltage applied to the input connector (within the voltage and frequency limits).
Model 93AD-08	Rear-signal input option.
Model 93AD-09	50Ω dBm display. (-50 to +60 dBm)
Model 93AD-10	75Ω dBm display (-50 to +60 dBm)
Model 93AD-15	600Ω dBm display (-60 to +50 dBm)
Model 93-1A	High-impedance probe accessory. Input impedance is 10 MΩ, $\leq$ 11.5 pF; attenuation 10X.
Model 92-1A	Rack-mounting kit, single.
Model 92-1B	Rack-mounting kit, dual.

CHAPTER II

OPERATION

2.1 INSTALLATION

The Model 93AD has been inspected and tested at the factory for compliance with specifications before packing, and is shipped ready for operation. If there is any indication of shipping damage to the instrument notify the carrier and the factory immediately.

2.1.1 Operating Controls and Indicators

ITEM	FUNCTION
Mode Switch	This three-position rotary switch turns the instrument power on when turned to the MANUAL position. If the 93AD-01 Option instrument is being used, the AUTO position of this switch puts the instrument in the autoranging mode. With the 93AD model, the instrument is inoperative in this switch position.
FULL SCALE Switch	This 12-position rotary switch selects the desired range. Full-scale ranges from 1 mV to 300 V, and dBm ranges are available.
RESPONSE TIME Switch	This adjusts the response time of the instrument to suit the frequency of the signal being measured. For frequencies below 200 Hz the switch must be in the SLOW position; for frequencies higher than 200 Hz, the switch can be in either position.

ITEM	FUNCTION
BANDWIDTH Switch	This restricts the instrument's bandwidth to the range 10 Hz to 20 MHz in one position, and to 10 Hz to 100 kHz in the other position. Unless the high frequency range is required, it is adviseable to leave this in the 100 kHz position.
DISPLAY Switch	In Models 93AD-09, 93AD-10, or 93AD-15 instruments, this switch shifts the display from volts to dBm. In the Model 93AD, this switch is inoperative.
INPUT Connector	A BNC connector to accept the probe cable connector.
Display	The LED display exhibits 3 digits +1, decimal point, units (V, mV, dBm), under and over range, and polarity of dBm. The small edgemeter furnishes an analog indication, calibrated in dBm over a range of 12 dBm. Useable for relative dBm indications, this meter will be found particularly useful for peaking or nulling adjustments - operations which are normally difficult using a digital readout alone.
(The following items are on the rear panel)	
RECORDER Terminals	The dc analog voltage output is available at these terminals for connection to external systems. (Also available at the rear edge-connector.)
Line Voltage Switch	This slide switch changes the power transformer primary from 115 to 230 volts. The voltage selected appears in the center of the switch slide.

ITEM	FUNCTION
Fuse Holder	Contains the line fuse for the instrument; either an 0.10 A or an 0.20 A fuse, depending on the line voltage, is used. The proper fuse value is indicated by the position of the voltage-change switch.
Edge Connector	All external control lines and outputs (BCD and analog) are available at this 22-pin connector. Mating connector recommended is an Amphenol 225-2221-103.
	This safety requirement symbol has been adopted by the International Electrotechnical Commission, document 66 (Central Office) 3, paragraph 5.3, which directs that an instrument be so labeled if, for the correct use of the instrument, it is necessary to refer to the instruction manual.

2.2 EQUIPMENT OPERATION

2.2.1 See that the voltage selector switch on the rear panel is set to the correct value for the line voltage available, and that the proper fuse is in the fuse holder. Plug the power cable into a receptacle, turn the MODE switch to MANUAL, and allow the instrument to warm up for a few minutes.

2.2.2 Attach the input cable to the INPUT connector. Because of possible unwanted pickup from strong external fields, it is usually best to use coaxial or shielded cable for this, terminated, of course, in a BNC connector. When measurements are going to be made primarily at low frequencies, and it is desired to use wire leads rather than coaxial cable, a BNC-to-binding post adapter may be used here. These are available from several sources; a representative type would be the Pomona Electronics No. 1296.

2.2.3 Set the RESPONSE TIME switch to the position appropriate for the frequency being measured. (FAST for frequencies higher than 200 Hz, SLOW for those lower.) The effect of the SLOW response is to reduce the influence of noise, hum, and other extraneous factors. When measuring high-frequency signals with these unwanted components, it is helpful to use the SLOW position also, unless a fast response is wanted.

2.2.4 Set the BANDWIDTH switch to the desired position - 0.1 MHz or 20 MHz. It should be noted that, although a low-frequency signal can be measured with the switch in the 20 MHz position, using the 0.1 MHz position will help to filter out unwanted high-frequency components that may degrade the measurement.

2.2.5 Set the FULL SCALE range switch to the expected range and apply the signal voltage to the input. The LED display should indicate the voltage value. If the display remains dark, but an upward (or downward) pointing arrow is illuminated, this indicates that the applied voltage is above (or below) the range in use.

NOTE

If, while the display is illuminated, the applied voltage is increased to a value higher than 5% above the maximum limit of the range in use, the display will blank out and the overrange arrow light. As the voltage is raised above this point (about 10% high), the display (and the arrow) will commence to flash alternately at a rate which increases as the voltage is raised. Higher still, the display will abruptly blank out and the overrange arrow will remain illuminated. This behavior is entirely normal, and results from the operation of internal protective circuits.

2.3 OPERATING NOTES

2.3.1 AC Signal with DC Component

The Model 93AD responds only to the ac component of a waveform. If it is necessary to include the dc component present in the signal, this dc should be measured separately with a dc voltmeter. After measuring the ac component with the 93AD, the true rms value may be computed from:

$$E_{rms} = (E_{dc}^2 + E_{ac}^2)^{1/2}$$

The dc component is blocked by an input capacitor with a maximum rating of 500 volts. If a dc component of higher value is present, an external blocking capacitor with a suitable rating must be connected externally in series with the high input terminal, with a 20MΩ resistor connected from the high terminal to ground. This capacitor must be at least 0.1 μF if it is desired to measure to the lowest specified frequency (10 Hz).

2.3.2 Effect of Crest Factor

The 93AD has a crest factor (ratio of peak to rms amplitude) capability of 6 at full scale, increasing proportionally to 18 at 1/3 scale. This may be expressed as:

$$CF = \frac{6}{K}$$

where K = fraction of fs indication

2.3.3 Measurement of Complex Waveforms

The 93AD measures the true rms value of complex waveforms independently of the phase relationship of the harmonics, provided that they lie within the instrument's frequency range. Harmonics falling outside this range can cause an error, which is a function of the relative energy of these harmonics and of the relative response of the instrument at these frequencies.

Although the calibrated range of the 93AD is from 10 Hz to 20 MHz, response actually extends beyond these limits. To compute the rms value of a voltage when the rms magnitudes of its components are known (which would include these out-band harmonics) the following equation may be used:

$$E_{rms} = (E_1^2 + E_2^2 + E_3^2 \ . \ . \ . \ E_n^2)^{1/2}$$

where E_{rms} = rms amplitude of complex waveform
E_1 = rms amplitude of the fundamental;
E_n = rms amplitude of n^{th} harmonic.

2.3.4 Measurement of RMS Current

The voltage drop caused by current flowing through a resistor can be measured with the Model 93AD, and the rms value of the current computed. Precision low-inductance resistors must be used in this application; disk or coaxial types are recommended. The crest factor is the same as that for voltage measurements.

2.3.5 Possible Sources of Error

A common cause of error in low-level measurements is ground currents - currents of signal, power, or other frequency flowing in a common lead impedance. This current flow results in a voltage, in addition to the desired voltage, appearing at the input terminal. Some of the methods for reducing or eliminating the effects of ground currents are:

a. A low-capacitance, high-resistance isolation transformer in the power-line leads. This is most effective in eliminating power and other low-frequency ground current loops.

b. Using coaxial signal leads, and keeping them as short as possible.

c. Making all known ground impedances as low as possible.

Another cause of error, which is apparent at high frequencies with long lengths of coaxial cable for signal connection, is a relatively high standing-wave ratio on the cable. This is best handled by using a matched system to operate the cable as a flat line.

A third possible source of error is the presence of strong magnetic or electrostatic fields, either around the leads or near the instrument. Shielding and/or spacing is usually effective in reducing this type of error.

2.3.6 Autoranging Operation

The Model 93AD-01 option instrument includes automatic range-switching circuitry. The correct range for the voltage applied is automatically selected when

the instrument is operated with the MODE switch in the AUTO position. The ranging circuits are triggered by the same section that controls the overrange and underrange indicators in non-automatic operation. When the overrange arrow lights, for instance, (at approximately 7% over the nominal top of a given range) the instrument automatically shifts to the next highest range. It should be noted that the 93AD actually has at least 5% overrange capability before range-changing is necessary. Down-ranging is triggered at approximately 16% below the down-scale point of the range in use (about 1/3-scale).

2.3.7 High-Impedance Probe Accessory

The Model 93-1A High-Impedance Probe increases the input impedance to 10 MΩ, ≤ 11.5 pF, and introduces a 10X attenuation factor. When used with the instrument with which it was calibrated, the probe introduces an additional uncertainty to specified accuracy. It is important that the frequency/voltage limits below be observed:

Frequency	Peak Voltage (dc + ac)
10 Hz - 6 MHz	500
6 MHz - 7 MHz	400
7 MHz - 10 MHz	300
10 MHz - 20 MHz	150

CHAPTER III

CIRCUIT DESCRIPTION

3.1 GENERAL

The basic circuitry of the Model 93AD is shown in the Block Diagram, Figure 1. The major elements are the attenuator, the wide-band amplifier, mean-square detector, chopper, linear detector, square-root amplifier, and the digital control and indicator circuits.

3.1.1 The ac input signal is passed through the blocking capacitor to the input attenuator and then to the wide-band amplifier. A diode protective circuit across the amplifier input limits the input voltage to a safe value; the instrument is protected up to at least 350 volts rms to 1 kHz on the three lowest ranges. The amplifier provides a gain of 5 across the band of 10 Hz to more than 20 MHz; its output appears across the output attenuator. The input attenuator has 0, 40, and 80 dB steps, the output attenuator has 0, 10, 20, and 30 dB steps. The two sections, controlled by the range switching circuits, are connected in various combinations to yield a total attenuation range of 0 to 110 dB in 10 dB steps.

Both attenuator sections are of the resistance-capacitance type, using high-stability components. At low frequencies the attenuation ratio is determined by the resistors; at the higher frequencies, by the capacitors. The crossover from resistive to capacitive attenuation occurs at about 25 kHz.

3.1.2 The signal voltage from the wide-band amplifier and output attenuator enters the mean-square detector. This detector converts the input ac signal to a balanced dc signal whose amplitude corresponds to the mean value of the square of the input voltage. The RESPONSE TIME switch on the instrument panel controls the time constants of this detector circuit to provide fast or slow response time as needed.

3.1.3 From the mean-square detector the balanced dc signal goes to the chopper; this solid-state modulator converts the dc to a 94 Hz square wave ac signal which then goes to the following amplifier. The frequency of 94 Hz is used to reduce the effects of power-supply primary line frequencies, and to eliminate any dependence upon the line frequency for operation. This enables the instrument to operate on any of the standard power-line frequencies between 50 and 400 Hz.

3.1.4 The modulated signal from the chopper goes to the 94 Hz amplifier, with a voltage gain of 10^4. Broadly tuned to the chopper frequency, this amplifier reduces much of the wide-band noise which may be present.

3.1.5 The ac signal from the 94 Hz amplifier is rectified in the linear detector and passes, via the buffer amplifier, to the square-root amplifier. This is a non-linear shaping amplifier whose output is proportional to the square root of the input voltage ($E_o = KE^{1/2}$). The dc output of this amplifier appears at the RECORDER terminals on the rear panel, and goes as well to the Digital Control circuits and the small panel analog meter.

3.1.6 The analog dc signal from the square root amplifier is processed by the digital control circuits; these extract information for range indication, decimal point position, overrange and underrange indication, polarity, and unit identification (volts, mV, or dBm). The digital control section also contains the circuitry for dBm readout when this option has been purchased, and for automatic range control in autorange option instruments.

3.1.7 The processed signal information from the digital control section is fed to the digital panel meter. The DPM circuits regulate the display, which uses light-emitting diodes for the numerical readout, and also provide the binary-coded decimal data outputs to the rear panel connector for external use.

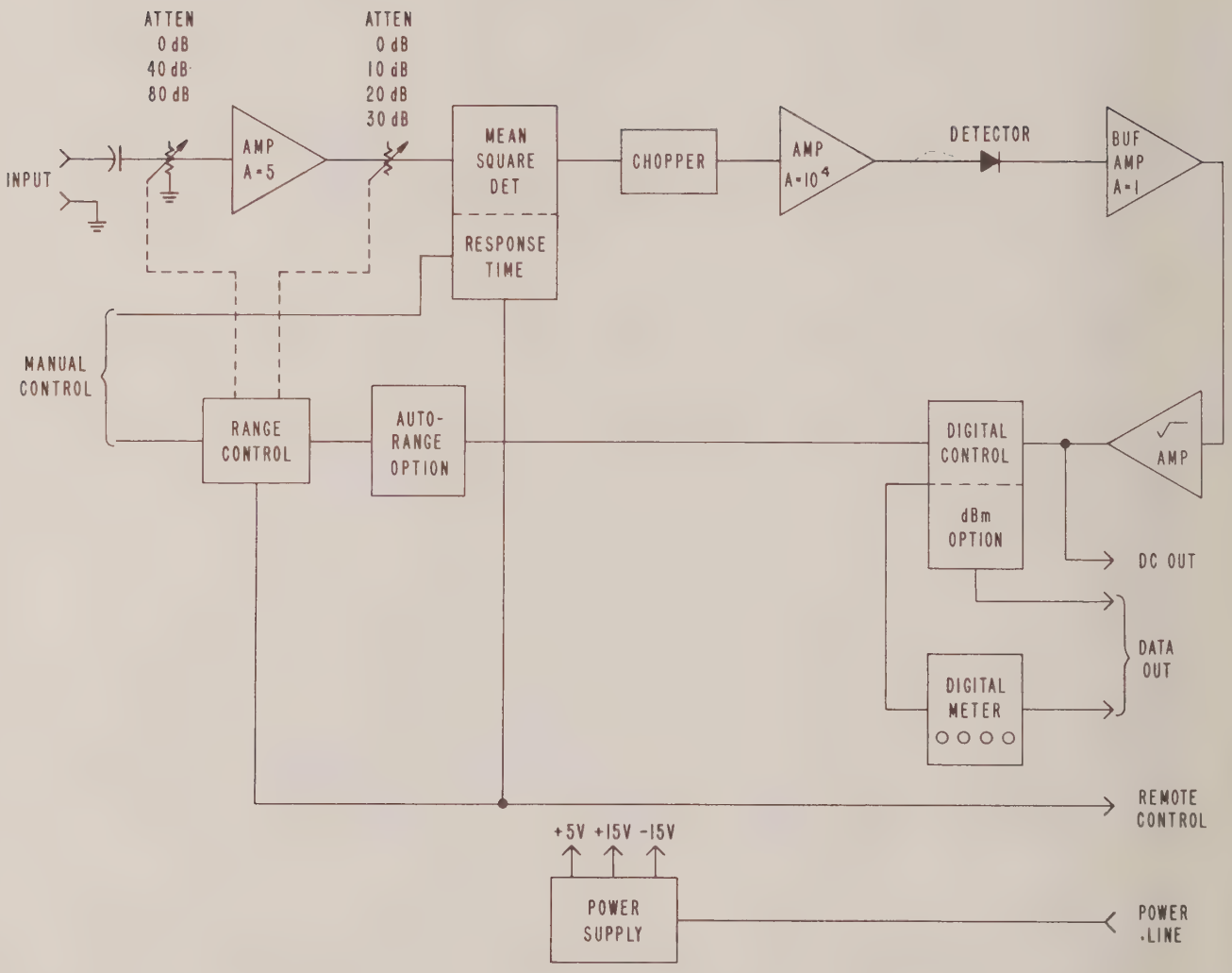


Figure 1: Model 93AD Block Diagram

CHAPTER IV

MAINTENANCE

4.1 INTRODUCTION

The Model 93AD is designed conservatively, and should deliver accurate performance for long periods of time without requiring service. However, as with any instrument of comparable accuracy and performance, it is always advisable to check its calibration from time to time to ensure that the specified accuracy is being obtained. The procedures that follow will enable the user to determine, with a minimum of equipment and time, whether or not the instrument is within specification limits.

4.2 OPERATIONAL CHECK

4.2.1 Connect the 93AD to the ac power line, turn the MODE switch to the MANUAL position, and allow the instrument to warm up for at least 15 minutes. If it has been stored at an ambient temperature significantly different from 25°C, allow a warmup period of at least one hour.

4.2.2 Connect a calibrated voltage source to the input of the 93AD. This source should provide a voltage of 1 mV to 100 V, at a frequency between 400 Hz and 1 kHz.

4.2.3 With these conditions satisfied, make the following tests:

Step 1 - Set the 93AD to the 1 mV range, and the source to 1 mV. Record the reading obtained. Do the same for all the other ranges: set the voltage source for the maximum value for each range on the 93AD, measure and record the reading at each range.

Step 2 - Set the voltage source to 100 V, and the 93AD range switch to the 300 V position. Read and record. Then set the source to 3 mV, and the 93AD to 10 mV. Read and record.

The readings obtained in Step 1 should be within ±0.2% plus the uncertainty of the calibrated voltage source.

The readings obtained in Step 2 should be within ±1% plus the source uncertainty.

4.2.4 If the instrument does not meet the uncertainty limits specified in 4.2.3, the full-scale indications may be adjusted to conform as follows:

a. Remove the cover by taking out the screw at the rear of the cover.

b. With the 93AD range switch set to the 10 V position, inject 10 V from the calibrated voltage source into the input. Adjust R539 to set the reading to 10 V. Check the other ranges in the 1-10-100 series in similar fashion. The original setting of R539 on the 10 V range should hold through all these ranges. If it does not, set it for an average reading between the highest and lowest readings.

c. Set the 93AD range switch to the 3 V position, and the calibrated source to 3 V. Adjust R740 until the reading is 3 V, then check the other ranges in the 3-30-300 series for agreement. As before, they should all agree once the setting has been made on the one range.

4.2.5 If calibrated sources are available at frequencies other than the 400 Hz-1 kHz range, similar procedures may be followed at other frequencies. For the allowable errors, see the chart in Section 1.2: Specifications.

4.2.6 If the 93AD meets the uncertainty limits specified in Section 4.2.3, it may be assumed that it will operate in satisfactory fashion throughout its frequency range.

Model 93AD

Table of Replaceable Parts

Reference		Description	BEC Part Number
A501	Op. Amp.	LM301A	535002
A502	"	µA725C	535008
A503	"	LM301A	535002
A504	"	"	"
A505	"	"	"
A601	Op. Amp.	LM310	535005
A602	"	LM301A	535002
A603	"	"	"
A604	"	"	"
A701	Op. Amp.	LM301A	535002
A702	"	"	"
A703	"	"	"
A704	"	"	"
A705	"	"	"
A706	"	"	"
C101	Capacitor, Elect.	250 µF 40 V	283207
C102	" "	100 µF 25 V	283105
C103	" Cer.	10 nF 100 V	224119
C104	" Elect.	1000 µF 16 V	283223
C105	" "	250 µF 40 V	283207
C106	" "	100 µF 25 V	283105
C107	" Cer.	10 nF 100 V	224119
C108	" Elect.	1000 µF 15 V	283223
C109	" "	500 µF 6 V	283222
C201	Capacitor, PE	22 nF 600 V 5%	234087
C202	" Cer.	1 nF 500 V GMV	224114
C203	" "	"	"
C204	" "	"	"
C205	" "	8.2 pF 500 V ±0.5 pF	220125
C206	" "	"	"
C207	" , Var.	0.7 - 3 pF 350 V	279122
C208	" "	"	"
C209	" , Mica	300 pF 500 V 5%	200077
C210	" "	"	"
C211	" , Var.	0.7 - 3 pF 350 V	279109

Reference		Description	BEC Part Number
C212	Capacitor, Mica	300 pF 500 V 5%	200077
C213	" , Cer.	1 nF 500 V	224114
C214	" "	"	"
C215	" "	"	"
C216	" "	"	"
C217	" , Elect.	6.8 µF 10% 35 V	283217
C218	" "	"	"
C219	" "	"	"
C220	" , Cer.	1000 pF 500 V	227106
C221	" "	"	"
C222	" "	"	"
C223	" , Elect.	47 µF 20 V 10%	283219
C224	" "	500 µF 2.5 V	283220
C225	" "	27 µF 25 V 10%	283218
C226	" "	6.8 µF 35 V 10%	283217
C227	" "	1 µF 35 V 10%	283216
C228	" "	47 µF 20 V 10%	283219
C229	" , Var.	4.5 - 50 pF 250 V	281006
C230	" , Elect.	47 µF 20 V 10%	283219
C301	Capacitor, Cer.	1 nF 500 V	224114
C302	" "	"	"
C401	Capacitor, Elect.	15 µF 20 V 10%	283227
C402	" "	"	"
C403	" "	1 µF 35V 10%	283216
C404	" "	"	"
C405	" "	4.7 µF 10V 10%	283226
C406	" "	"	"
C501	Capacitor, Mica	24 pF 500 V 5%	200009
C502	" "	750 pF 300 V 5%	200081
C503	" "	6 pF 500 V 0.5%	200078
C504	" , Cer.	1 nF 500 V	224114
C505	" "	"	"
C506	" "	"	"
C507	" "	"	"
C508	" , Mica	36 pF 500 V 5%	200079
C509	" , Elect.	2 µF 50 V	283229
C510	" "	"	"
C511	" "	"	"
C512	" "	"	"
C513	" , PE	10 nF 200 V 5%	234061
C514	" , Elect.	47 µF 20 V 10%	283219
C515	" , Cer.	10 nF 100 V	224119
C516	" , Elect.	250 µF 16 V -10% +50%	283224

Reference		Description	BEC Part Number
C517	Capacitor, Cer.	33 pF 500 V 5%	224139
C518	" "	10 nF 100 V	224119
C519	" , Elect.	250 µF 16 V -10% +50%	283224
C520	" , Cer.	10 nF 100 V	224119
C521	" , Var.	6 - 70 pF	281010
C522	" , Cer.	33 pF 500 V 5%	224139
C523	" , PE	100 nF 250 V 20%	234080
C524	" "	"	"
C525	" , Elect.	56 µF 6 V 10%	283228
C526	" , Cer.	10 nF 100 V	224119
C527	" "	"	"
C528	" "	"	"
C529	" , Elect.	6.8 µF 35 V 10%	283217
C530	" "	4.7 µF 10 V 10%	283226
C531	" , Cer.	10 nF 100 V	224119
C532	" "	"	"
C533	" "	33 pF 500 V 5%	224139
C534	" "	10 nF 100 V	224119
C535	" , Mica	75 pF 500 V 5%	200059
C536	" , Cer.	10 nF 100 V	224119
C537	" "	"	"
C538	" , PE	220 nF 250 V 10%	234088
C539	" , Cer.	10 nF 100 V	224119
C540	" "	"	"
C541	" "	33 pF 5-0 V 5%	224139
C542	" "	10 nF 100 V	224119
C601	Capacitor, Cer.	10 nF 100 V	224119
C602	" "	"	"
C603	" "	"	"
C604	" "	33 pF 500 V 5%	224139
C605	" , PC	100 nF 50 V 10%	234046
C606	" , Cer.	10 nF 100 V	224119
C607		Selected	234090
C608	" , PE	10 nF 200 V 5%	234061
C609	" , Cer.	10 nF 100 V	224119
C610		Selected	234090
C611	" "	33 pF 500 V 5%	224139
C612	" "	10 nF 100 V	224119
C613	" , Mica	100 pF 500 V 5%	200001
C614	" , Cer.	10 nF 100 V	224119
C615	" "	"	"
C701	Capacitor, Cer.	10 nF 100 V	224119
C702	" "	"	"
C703		Not used	
C704	" "	33 pF 500 V 5%	224139
C705	" "	"	"

Reference	Description	BEC Part Number
R101	Resistor, Comp. 10 kΩ 5% 1/4W	300106
R102	" " "	"
R103	" " "	"
R104 to R116	" " "	"
R117	" , WW 10 Ω 5% 2W	310008
R118	" , Comp. 100 Ω 5% 1/2W	301063
R119	" , MF 4.53 kΩ 1% 3/8W	340318
R120	" , Comp. 2.2 kΩ 5% 1/2W	301095
R121	" , Var. 500 Ω 20% 1/2W	311296
R122	" , Comp. 2.2 kΩ 5% 1/2W	301095
R123	" , MF 1.47 kΩ 1% 3/8W	326260
R124	" , Comp. 100 Ω 5% 1/2W	301063
R125	" , WW 10 Ω 5% 2W	310008
R126	" , Comp. 100 Ω 5% 1/2W	301063
R127	" , MF 4.53 kΩ 1% 3/8W	340318
R128	" , Var. 500 Ω 20% 1/2W	311296
R129	" , MF 1.47 kΩ 1% 3/8W	326260
R130	" , Comp. 33 Ω 5% 1/2W	301051
R201	Resistor, Network 1.98 MΩ	345000
R202	" " "	345001
R203	Resistor, Comp. 6.8 Ω 5% 1/4W	300300
R204	" " "	"
R205	" , MF 1 MΩ 1% 3.8W	326700
R206	" " "	"
R207	Resistor, P/O Net. 20.02 kΩ 1% 1.4W	345000
R208	" " 19.8 kΩ 1% 1/4W	345001
R209	" " 200 Ω 1% 1/4W	345001
R210	Resistor, Comp. 470 Ω 5% 1/2W	301079
R211	" " 150 Ω 5% 1/4W	300062
R212	" , MF 2.74 kΩ 1% 1/4W	325387
R213	" , " 1.00 kΩ 1% 1/4W	325375
R214	" " 27.4 Ω 1% 1/4W	325201
R215	" , Comp. 47 Ω 5% 1/4W	300050
R216	" , MF 82.5 kΩ 1% 1/4W	325475
R217	" , Comp. 47 Ω 5% 1/4W	300050
R218	" , MF 3.09 k% 1% 1/4W	325383
R219	" , Comp. 47 Ω 5% 1/4W	300050
R220	" " "	"
R221	" " "	"
R222	" " 22 kΩ 5% 1/4W	300114
R223	" " 180 Ω 5% 1/4W	300064
R224	" , MF 1.00 kΩ 1% 1/4W	325375

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Reference		Description	BEC Part Number
R225	Resistor, Comp.	47 Ω 5% 1/4W	300050
R226	" "	220 Ω 5% 1/4W	300066
R401	Resistor, MF	100 kΩ 1% 3/8W	340478
R402	" "	"	"
R501	Resistor, Comp.	150 kΩ 5% 1/2W	301139
R502*	" , MF	93.42 Ω 2%	345002
R503*	" "	"	"
R504*	" "	63.88 Ω 2%	"
R505*	" "	138.12 Ω 2%	"
R506*	" "	"	"
R507*	" "	"	"

*Resistor network, matched to 0.1%

R509	Resistor, Comp.	330 Ω 5% 1/2W	301075
R510	" , Var.	1 MΩ 20% 0.5W	311299
R511	" , MF	1 MΩ 1% 3/8W	326700
R512	" , Comp.	68 Ω 5% 1/2W	301059
R513	" "	"	"
R514	" "	3.3 kΩ 5% 1/2W	301099
R515	" "	510 Ω 5% 1/2W	301080
R516	" , MF	174 kΩ 1% 3/8W	340507
R517	" "	162 kΩ 1% 3/8W	340503
R518	" , Comp.	10 kΩ 5% 1/2W	301111
R519	" "	510 Ω 5% 1/2W	301080
R520	" "	10kΩ 5% 1/2W	301111
R521	" , MF	2 kΩ 1% 3/8W	326265
R522	" , Var.	5 kΩ 20% 0.5W	311297
R523	" , MF	6.04 kΩ 1% 3/8W	340333
R524	" "	634 kΩ 1% 3/8W	340575
R525	" "	"	"
R526	" "	2 kΩ 1% 3/8W	326265
R527	" , Var.	5 kΩ 20% 0.5W	311297
R528	" , MF	6.04 kΩ 1% 3/8W	340333
R529	" , Comp.	10 MΩ 5% 1/2W	301183
R530	" "	1.2 MΩ 5% 1/2W	301161

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Reference		Description	BEC Part Number
R531	Resistor, Comp.	100 kΩ 5% 1/2W	301135
R532	" "	"	"
R533	" , MF	100 Ω 1% 3/8W	326031
R534	" , CF	2 MΩ 1% 1/2W	306719
R535	" "	"	"
R536	" , Comp.	47 Ω 5% 1/2W	301055
R537	" , MF	1 MΩ 1% 3/8W	326700
R538	" "	1.69 KΩ 1% 3/8W	340269
R539	" , Var.	500 Ω 10% 1/2W	311281
R540	" , Comp.	10 KΩ 5% 1/2W	301111
R541	" , MF	10 KΩ 1% 3/8W	326376
R542	" , Comp.	240 KΩ 5% 1/2W	301144
R543	" , MF	499 KΩ 1% 2/8W	326561
R544	" , Var.	500 KΩ 20% 1/2W	311298
R545	" , MF	499 KΩ 1% 3/8W	326561
R546	" , Comp.	4.7 MΩ 5% 1/4W	300170
R547	" , MF	100 KΩ 1% 3/8W	340478
R548	" , Comp.	1 KΩ 5% 1/2W	301087
R549	" "	2.2 MΩ 5% 1/4W	300162
R550	" , MF	124 KΩ 1% 3/8W	340490
R551	" , MF	100 KΩ 1% 3/8W	340478
R552	" , Comp.	300 Ω 5% 1/2W	301074
R601	Resistor, Comp.	910 Ω 5% 1/2W	301086
R602	" , MF	71.5 KΩ 1% 3/8W	340461
R603	" , Var.	20 KΩ 20% 1/2W	311279
R604	" , WW	50 KΩ 0.1% 1/2W	309442
R605	" , CF	2 MΩ 1% 1/2W	306719
R606	" , Var.	1 KΩ 20% 1/2W	311301
R607	" , MF	100 KΩ 1% 3/8W	340478
R608	" , Comp.	910 Ω 5% 1/2W	301086
R609	" , MF	1.19 KΩ 1% 3/8W	340244
R610	" , Comp.	100 KΩ 5% 1/2W	301135
R611	" , Var.	20 KΩ 10% 1W	311266
R612	" , Comp.	100 KΩ 5% 1/2W	301135
R613	" , MF	71.5 KΩ 1% 3/8W	340461
R614	" "	"	"
R615	" , Comp.	100 KΩ 5% 1/2W	301135
R616	" , MF	50 KΩ 1% 3/8W	326407
R617	" , Comp.	100 KΩ 5% 1/2W	301135
R618	" , MF	301 Ω 1% 3/8W	340176
R619	" , Var.	20 KΩ 20% 1/2W	311279
R620	" , MF	30.1 KΩ 1% 3/8W	326397
R621	" "	487 KΩ 1% 3/8W	340560
R622	" , WW	50 KΩ 0.1% 1/2W	309442
R623	" , MF	10 KΩ 1% 3/8W	326376
R624	" "	4.75 KΩ 1% 3/8W	326285

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Reference	Description	BEC Part Number
R625	Resistor, Var. 500 KΩ 20% 1/2W	311298
R626	" , MF 1.78 KΩ 1% 3/8W	326262
R627	" , Comp. 4.7 MΩ 5% 1/2W	301175
R628	" , MF 100 KΩ 1% 3/8W	340478
R629	" , Var. 1 KΩ 20% 1W	311256
R630	" , Comp. 13 KΩ 5% 1/2W	301114
R701	Resistor, Comp. 3.3 KΩ 5% 1/2W	300094
R702	" , MF 401.5 KΩ 0.1% 3/8W	340803
R703	" " 200.5 KΩ 0.1% 3/8W	340802
R704	" " 100 KΩ 0.1% 3/8W	340801
R705	" " 49.8 KΩ 0.1% 3/8W	340800
R706	" , Comp. 33 KΩ 5% 1/2W	301123
R707	" , MF 9.76 KΩ 1% 3/8W	340358
R708	" , Var. 2 KΩ 10% 1W	311264
R709	" , MF 1 KΩ 1% 3/8W	340239
R710	" " 49.9 KΩ 1% 3/8W	340442
R711	" , Comp. 22 KΩ 5% 1/2W	300114
R712	" " 10 KΩ 5% 1/4W	300106
R713	" , MF 140 KΩ 1% 3/8W	340496
R714	" " 750 KΩ 1% 3/8W	326583
R715	" " 100 KΩ 1% 3/8W	340478
R716	" " 124 KΩ 1% 3/8W	340490
R717	" , Comp. 100 K2 5% 1/2W	301135
R718	" " "	"
R719	" , Var. 20 KΩ 10% 1W	311266
R720	" , MF 60.4 KΩ 1% 3/8W	340452
R722	" , MF 93.1 KΩ 1% 3/8W	340475
R723	" , Comp. 82 KΩ 5% 1/4W	300128
R724	" " 120 KΩ 5% 1/4W	300132
R725	" " "	"
R726	" , MF 49.9 KΩ 5% 3/8W	340442
R727	" , Comp. 330 KΩ 5% 1/4W	300142
R728	" " 1 MΩ 5% 1/4W	300154
R729	" " 120 KΩ 5% 1/4W	300132
R730	" " "	"
R731	" , Var. 10 KΩ 10% 1W	311267
R732	" , MF 29.4 KΩ 1% 3/8W	340415
R733	" " 15.8 KΩ 1% 3/8W	340382
R734	" , Var. 10 KΩ 10% 1W	311267
R735	" , Comp. 33 KΩ 5% 1/2W	301123
R736	" , MF 60.4 KΩ 1% 3/8W	340452
R737	" " 2 KΩ 1% 3/8W	326265
R738	" " 19.1 KΩ 1% 3/8W	340392
R739	" " 665 Ω 1% 3/8W	340218
R740	" , Var. 50 Ω 10% 1W	311300

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Reference		Description	BEC Part Number
R741	Resistor, MF	294 Ω 1% 3/8W	340177
R742	" "	100 KΩ 1% 3/8W	340478
R743	" "	19.1 KΩ 1% 3/8W	340392
R744	" "	1 KΩ 1% 3/8W	340239
CR101	Rectifier, Bridge	KBP-02	532013
CR102	" "	"	"
CR103	" "	"	"
CR104	Diode, Zener	1N5730B	530116
CR201	Diode, Silicon	1N914	530058
CR202	" "	"	"
CR203	" "	"	"
CR204	" "	"	"
CR401, 402		Matched diode pair	530121
CR501	Diode, Silicon	1N914	530058
CR502 to CR507	" "	"	"
CR601	Diode, Zener	1N821	530050
CR602	" , Silicon	1N914	530085
CR603	" , Zener	1N5736B	530117
CR604	" , Silicon	1N914	530085
CR605	" "	"	"
CR606	" , Zener	1N5738B	530132
CR701	Diode, Zener	1N821	530050
CR702	" "	1N5731B	530128
CR703	" "	"	"
CR704	" , Silicon	1N914	530058
CR705	" "	"	"
CR706	" "	"	"
CR707	" "	"	"

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Reference		Description		BEC Part Number
F301	Fuse	1/10 Amp 235 V		545519
F301	"	2/10 Amp 117 V		545508
IC101	Int. Circuit	Nand Gate	SN74L10N	534029
IC102	" "	" "	SN74L20N	534030
IC103	" "	" "		"
IC104	" "	Hex Inverter	SN74L04N	534028
IC105	" "	"	"	"
IC106	" "	Regulator	MFC6030	535007
IC107	" "	Hex Inverter	SN74L04N	534028
IC601	Int. Circuit		CD4001AE	534023
IC602	" "		CD4013AE	534021
IC701	Int. Circuit	Nand Gate	SN74L30N	534031
IC702	" "	" "	"	"
IC703	" "	" "	"	"
IC704	" "	" "	SN74L20N	534030
IC705	" "	" "	SN74L00N	534002
IC706	" "	" "	"	"
IC707	" "	" "	SN74L30N	534031
IC708	" "	Quad Switch	CD4016AE	534007
IC709	" "	Nand Gate	SN74L30N	534031
IC710	" "	" "	SN74L20N	534030
K201	Relay	Reed Switch		471012
K202	"	" "		"
K203	"	" "		"
K204	"	" "		471014
K205	"	" "		"
K501	Relay	Reed Switch		471014
K502	"	" "		471013
K503	"	" "		"
K504	"	" "		"
L201	Coil, Adj.	0.108 - 0.135 μH		400254

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Reference	Description		BEC Part Number
M301	Meter		554255
Q201	Transistor	MPS3638	528064
Q202	"	"	"
Q203	"	2N4221A	528063
Q204	" Pair		528067
Q205	" "	"	"
Q401	Transistor	MOS FET HDGP1000	528066
Q402	"	" "	"
Q403	"	" HDGP1001	528057
Q404	"	" "	"
Q405,406	"	FET matched pair	528069
Q501	Transistor	PNP 2N5653	528056
Q502	"	FET 2N5459	528019
Q503	"	NPN SE3003	528065
Q504	"	PNP 2N5653	528056
Q505	"	NPN MPSA20	528043
Q506	"	" "	"
Q507	"	PNP MPS3638	528064
Q601	Transistor	MOS FET HDGP1001	528057
Q602	"	FET TIS58	528038
Q603	"	" "	"
Q604	"	NPN MPSA20	528043
Q605	"	MOS FET HDGP1001	528057
Q701	Transistor	MPS3638	528064
Q702	"	"	"
Q703	"	"	"
Q704	"	"	"
Q705	"	CA3046	528058
Q706	"	2N5653	528056
Q707	"	"	"
Q708	"	"	"
Q709	"	"	"
RT701	Thermistor	1 KΩ 1%	325006

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Model 93AD-01 Option

(Autorange)

Table of Replaceable Parts

Reference		Description		BEC Part Number
C801	Capacitor, Elect.	33µF 10% 25V		283230
C802	" "	15µF 10% 20V		283227
C803	" "	400µF 16V -10% +50%		283225
C804	" , Cer.	10nF 100V		224119
C805	" , Elect.	400µF 16V -10% +50%		283225
C806	" , Cer.	10nF 100V		224119
CR801 to CR817	Diode, Silicon		1N914	530058
			"	"
IC801	Int. Circuit	Up/Down Counter	N8284A	534026
IC802	" "	Decoder	U6N93L1159X	534025
IC803	" "	Nand Gate	SN74L00N	534002
IC804	" "	Nor Gate	SN7402N	534027
Q801	Transistor	PNP	MPS3638	528064
Q802	"	"	"	"
Q803	"	FET	2N5653	528056
Q804	"	Unijunction	2N4871	528051
R801	Resistor, Comp.	22 kΩ 5% 1/2W		301119
R802	" "	120 kΩ 5% 1/2W		301137
R803	" "	1 MΩ 5% 1/2W		301159
R804	" "	120 kΩ 5% 1/2W		301137
R805	" "	10 kΩ 5% 1/2W		301111
R806	" "	300 Ω 5% 1/2W		301074
R807	" "	15 Ω 5% 1/2W		301043
R808	" "	2.2 kΩ 5% 1/2W		301095
R809	" "	4.7 Ω 5% 1/2W		301508

Digital Panel Meter

Reference		Description		BEC Part Number
A1401	Op. Amp.	Follower	LM310	535005
A1402	"		LM301A	535002
A1403	"	Follower	LM310	535005
A1404	"	Comparator	LM311	535006
C1201	Capacitor, Elect.	200 µF 6 V		283147
C1202	" , Mica	120 pF 500 V 5%*		200002
C1203	" "	56 pF 500 V 5% *		200030
C1204	" "	150 pF 500 V 5%*		200032
	" "	91 pF 500 V 5% *		200035
	" "	33 pF 500 V 5%*		200049
	*One of these to be selected during calibration.			
C1203	Capacitor, Var.	4.5 - 50 pF 250 V	281009	281009
C1204	" , Mica	33 pF 500 V 5%		200049
C1205	" , Mylar	10 nF 250 V 20%		234085
C1206	" "	100 nF 250 V 20%		234080
C1401	" , Elect.	1 µF 25 V 20%		283199
C1402	" "	"		"
C1403	" , PC	100 nF 50 V 10%		234046
C1404	" , Cer.	33 pF 500 V 5%		224139
C1405	" , Elect.	1 µF 25 V 20%		283199
C1406	" , PC	100 nF 50 V 10%		234046
CR1201	Diode, Zener	1N5234B		530093
CR1202	" "	"		"
CR1203	" , signal	1N914		530058
CR1204	" "	"		"
CR1301	Diode, signal	1N914		530058
CR1302	" "	"		"
CR1303	" "	"		"
CR1304	" "	"		"
CR1401	Diode, Zener	1N821		530050
CR1402	" "	"		"
CR1403	" , Signal	1N914		530058
CR1404	" "	"		"
CR1405	" "	"		"

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Reference		Description		BEC Part Number
DS1301		Numeric Display	MAN-1A	536800
DS1302		" "	"	"
DS1303		" "	"	"
DS1304	Lamp		2200D	545120
DS1305	"		"	"
DS1306	"		"	"
DS1307	"		"	"
DS1308		Numeric Display	MAN-1A	536800
DS1309	Lamp		2200D	545120
DS1310	"		"	"
DS1311	"		"	"
Q1201 to Q1208	Transistor	PNP	MPS6516	528037
	"	"	"	"
Q1209	"	NPN	MPS6507	528070
Q1210	"	"	MPS6512	528059
Q1211	"	"	"	"
Q1212	"	"	"	"
Q1213	"	PNP	2N 5087	528042
Q1214	"	NPN	MPS6512	528059
Q1215	"	PNP	2N5087	529042
Q1216	"	"	"	"
Q1217	"	"	"	"
Q1218	"	"	"	"
Q1219	"	NPN	MPS6512	528059
Q1220	"	Unijunction	MPU131	528062
Q1221	"	PNP	2N5087	528042
Q1222	"	"	"	"
Q1223	"	"	"	"
Q1224	"	"	"	"
Q1301 to Q1307	Transistor	NPN	MPS6512	528059
	"	"	"	"
Q1308 to Q1311	"		MPSA12	528052
	"		"	"
Q1312	"	PNP	2N5087	528042
R1201 to R1206	Resistor, Comp.	27 kΩ 5% 1/4W		300116
	" "	"		"
R1207	" "	2 kΩ 5% 1/4W		300089
R1208	" "	1 kΩ 5% 1/4W		300082
R1209	" "	5.1 kΩ 5% 1/4W		300099
R1210	" "	"		"
R1211 to R1214	" "	100 kΩ 5% 1/4W		300130
	" "	"		"

Reference		Description	BEC Part Number
R1215	Resistor, Comp.	27 kΩ 5% 1/4W	300116
R1216	" "	5.1 kΩ 5% 1/4W	300099
to			
R1220	" "	"	"
R1221	" "	27 kΩ 5% 1/4W	300116
R1222	" "	"	"
R1223	" "	680 Ω 5% 1/4W	300078
R1224	" "	"	"
R1225	" "	680 kΩ 5% 1/4W	300150
R1226	" "	100 kΩ 5% 1/4W	300130
R1227	" "	680 kΩ 5% 1/4W	300150
R1228	" "	5.1 kΩ 5% 1/4W	300099
R1229	" "	330 Ω 5% 1/4W	300070
R1230	" "	4.7 MΩ 5% 1/4W	300170
R1231	" "	5.1 kΩ 5% 1/4W	300099
R1232	" "	"	"
R1233	" "	"	"
R1234	" "	"	"
R1301	Resistor, Comp.	47 Ω 5% 1/4W	300050
to			
R1307	" "	"	"
R1308	" "	27 kΩ 5% 1/4W	300116
to			
R1311	" "	"	"
R1312	" "	330 Ω 5% 1/4W	300070
R1401	Resistor, MF	30.9 kΩ 1% 1/4W	325461
R1402	" "	"	"
R1403	" "	5.49 kΩ 1% 1/4W	325398
R1404	" "	"	"
R1405	" , Var.	5 kΩ 20% 1/2W	311293
R1406	" , MF	1.15 kΩ 1% 1/4W	325377
R1407	" "	200 kΩ 1% 1/4W	325585
R1408	" , Var.	5 kΩ 20% 1/2W	311293
R1409	" , Comp.	330 Ω 5% 1/4W	300070
R1410	" "	10 kΩ 5% 1/4W	300106
R1411	" , MF	1.15 kΩ 1% 1/4W	325377
R1412	" , Comp.	27 kΩ 5% 1/4W	300116
R1413	" "	4.7 MΩ 5% 1/4W	300170
R1414	" "	680 Ω 5% 1/4W	300078
R1415	" "	27 kΩ 5% 1/4W	300116
R1416	" "	5.1 kΩ 5% 1/4W	300099
R1417	" "	10 kΩ 5% 1/4W	300106
R1418	" "	4.7 MΩ 5% 1/4W	300170
R1419	" "	1 MΩ 5% 1/4W	300154

93AD
a-672

Warranty

Boonton Electronics Corporation warrants its products to the original Purchaser to be free from defects in material and workmanship and to operate within applicable specifications for a period of one year from date of shipment, provided they are used under normal operating conditions. This warranty does not apply to vacuum tubes that have given normal service, to sealed assemblies which have been opened, or to any item which has been repaired or altered without our authorization.

We will repair or, at our option, replace at no charge any of our products which are found to be defective under the terms of this warranty. Except for such repair or replacement, we will not be liable for any incidental damages or for any consequential damages, as those terms are defined in Section 2-715 of the Uniform Commercial Code, in connection with products covered by this warranty.

BOONTON ELECTRONICS CORPORATION

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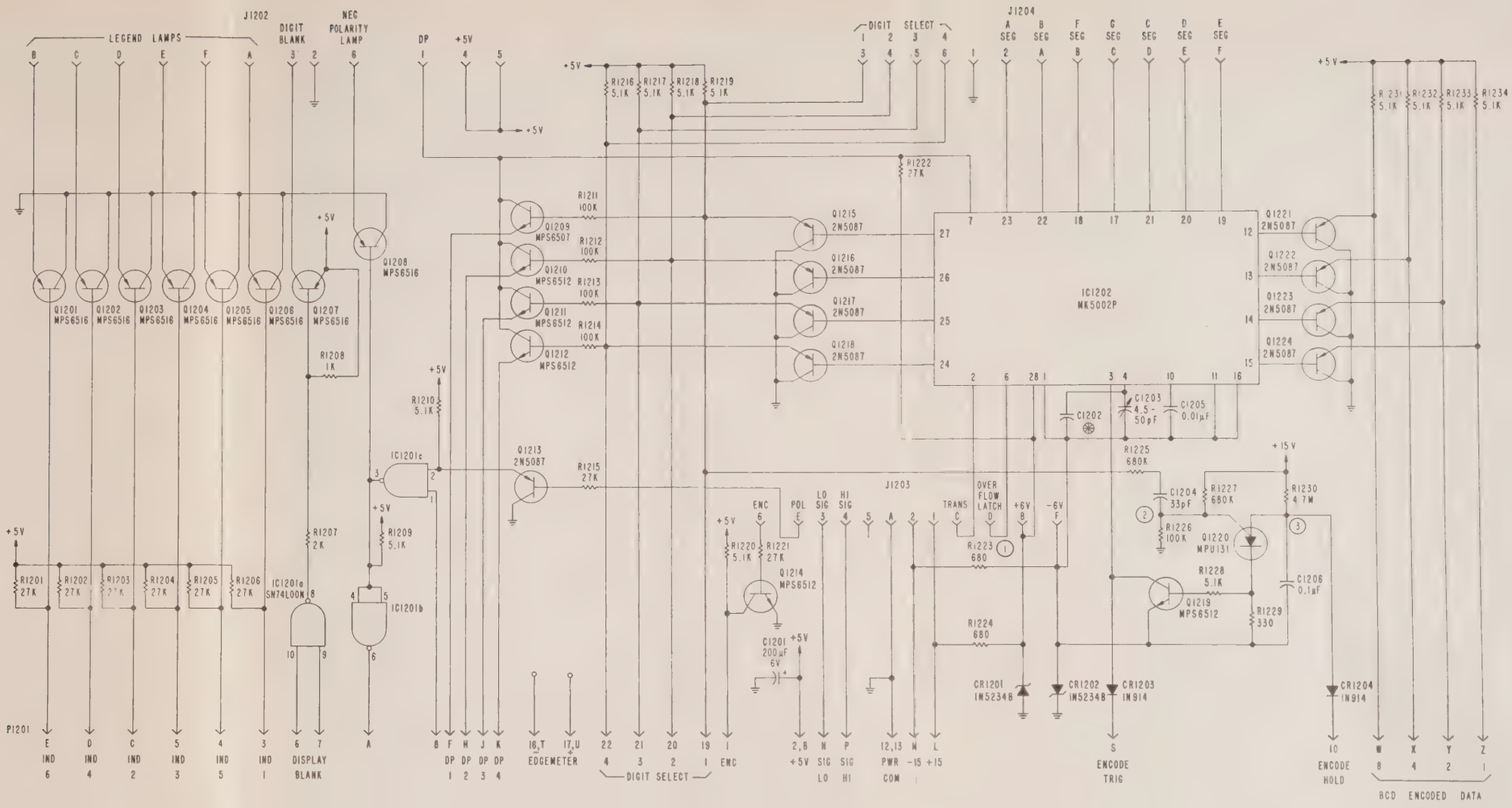
TWX: 710-986-8241
Route 287, Parsippany, N. J. – 07054



TEST POINT ① ② ③

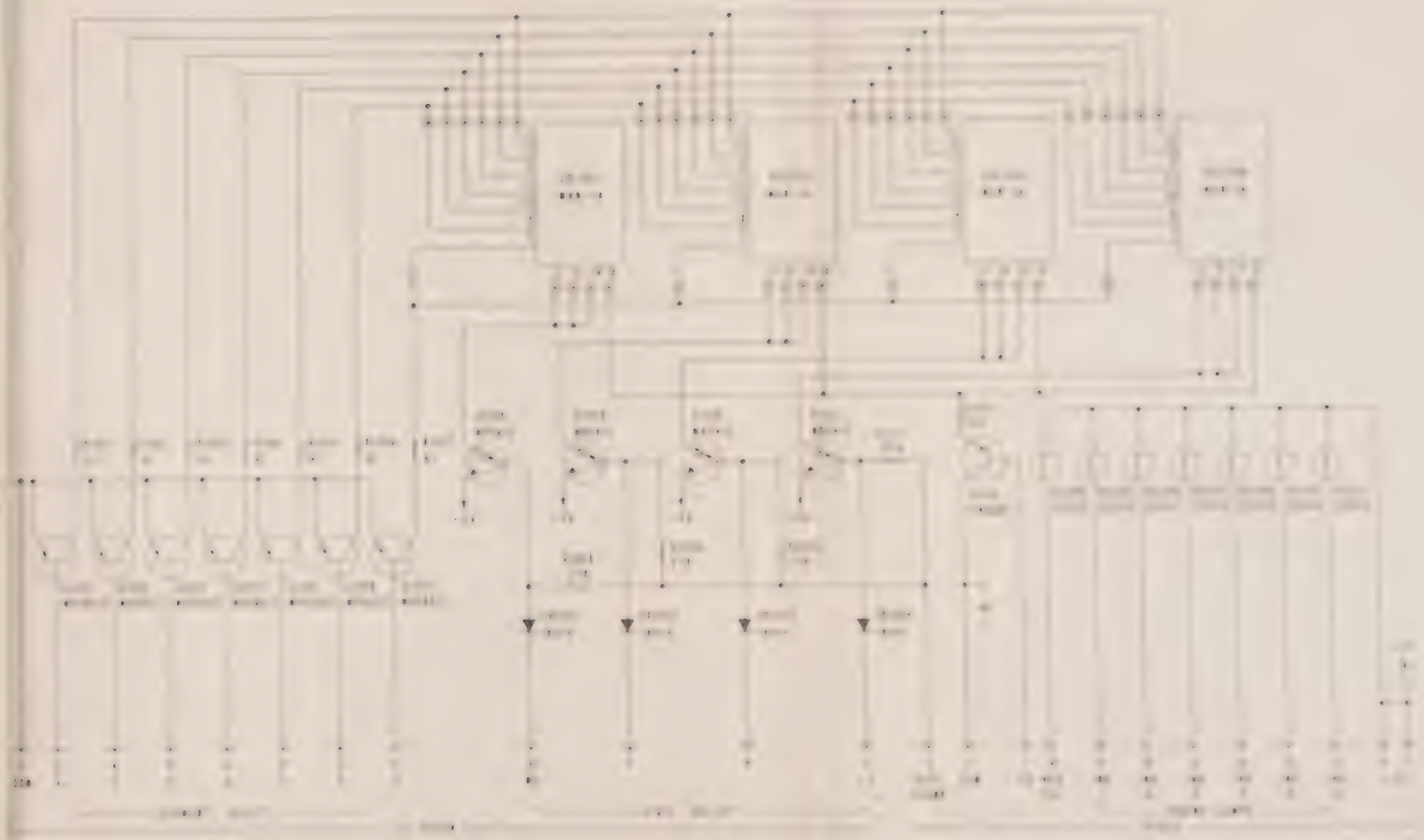
WAVEFORM

NOTES:

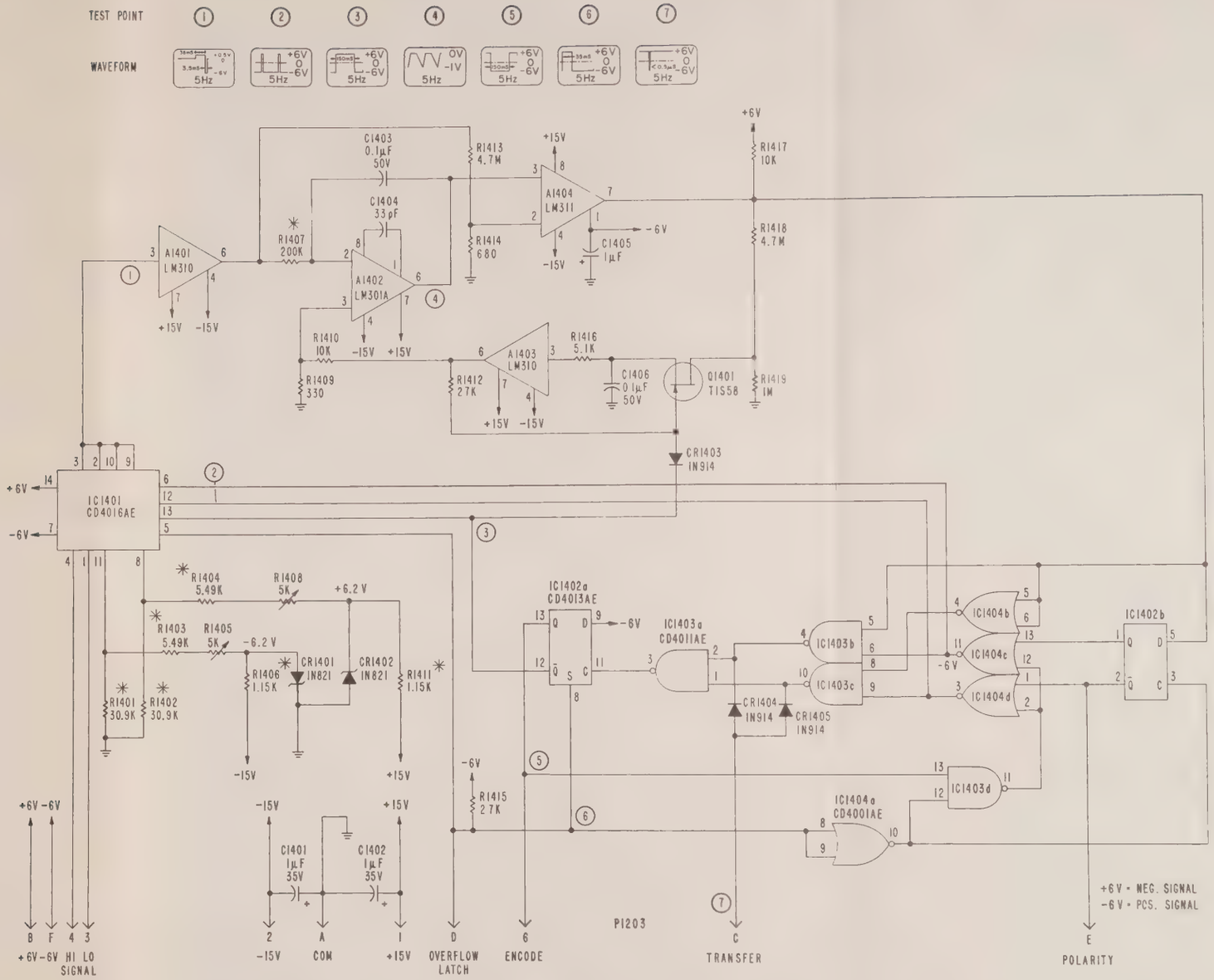
1. RESISTANCE VALUES IN OHMS AND 1/4 WATT, UNLESS OTHERWISE SPECIFIED.
2. ⊛ FACTORY SELECTED.
3. TEST CONDITIONS:
   ALL MEASUREMENTS MADE WITH +0.5V INPUT.
   ALL VALUES NOMINAL.
4. LAST NUMBERS USED:
   R1234 C1206 Q1224

BOONTON ELECTRONICS CORPORATION

Model 93AD
Schematic, Counter Board
E830546A (1 of 3)



BOONTON ELECTRONICS

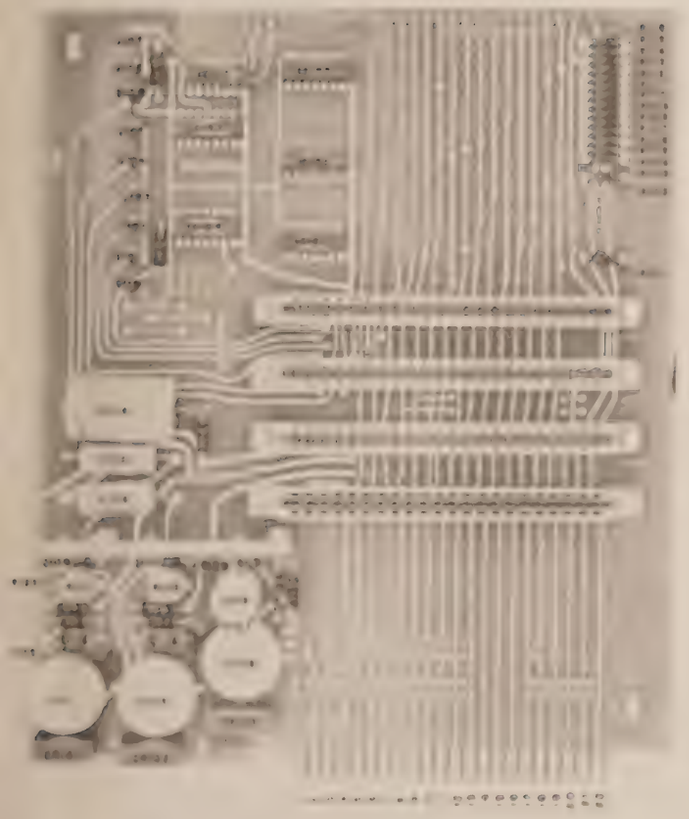


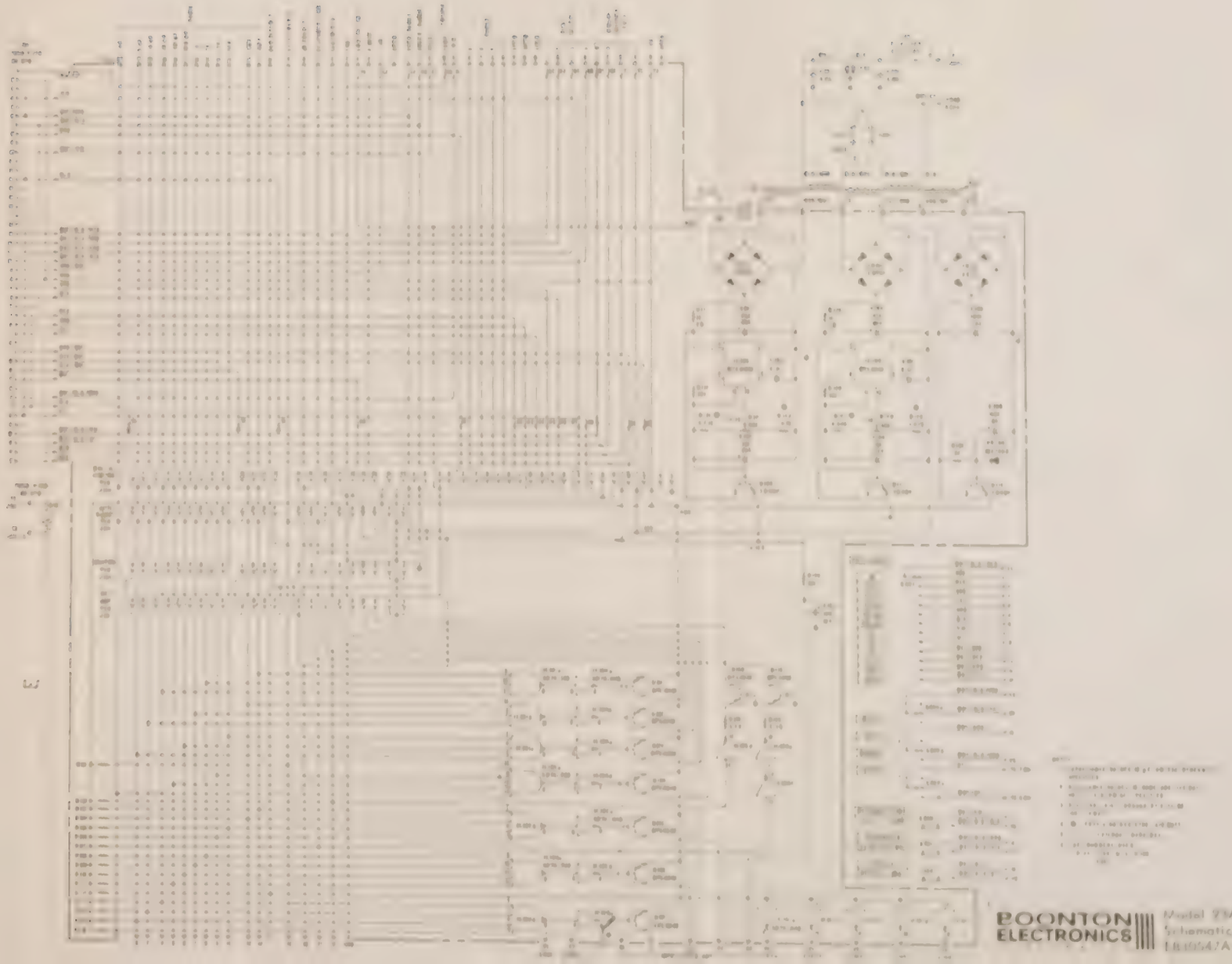
NOTES:

1. RESISTANCE VALUES IN OHMS AND 1/4 WATT, UNLESS OTHERWISE SPECIFIED.
2. ✳ PRECISION RESISTOR.
3. TEST CONDITIONS: ALL MEASUREMENTS MADE WITH +0.5 Vdc INPUT. ALL VALUES NOMINAL.
4. LAST NUMBERS USED: R1419 C1406

BOONTON ELECTRONICS CORPORATION

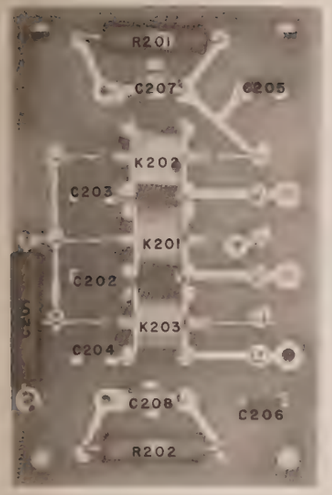
Model 93AD
Schematic, A/D Converter
D830546A (3 of 3)

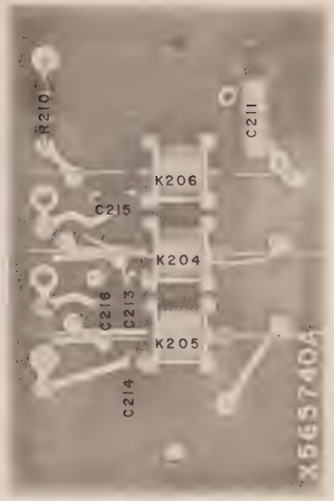


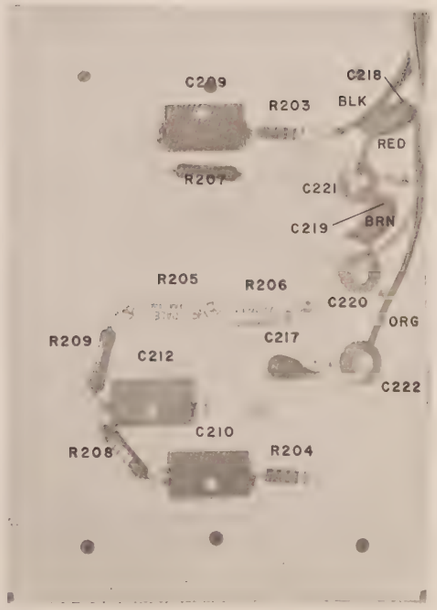


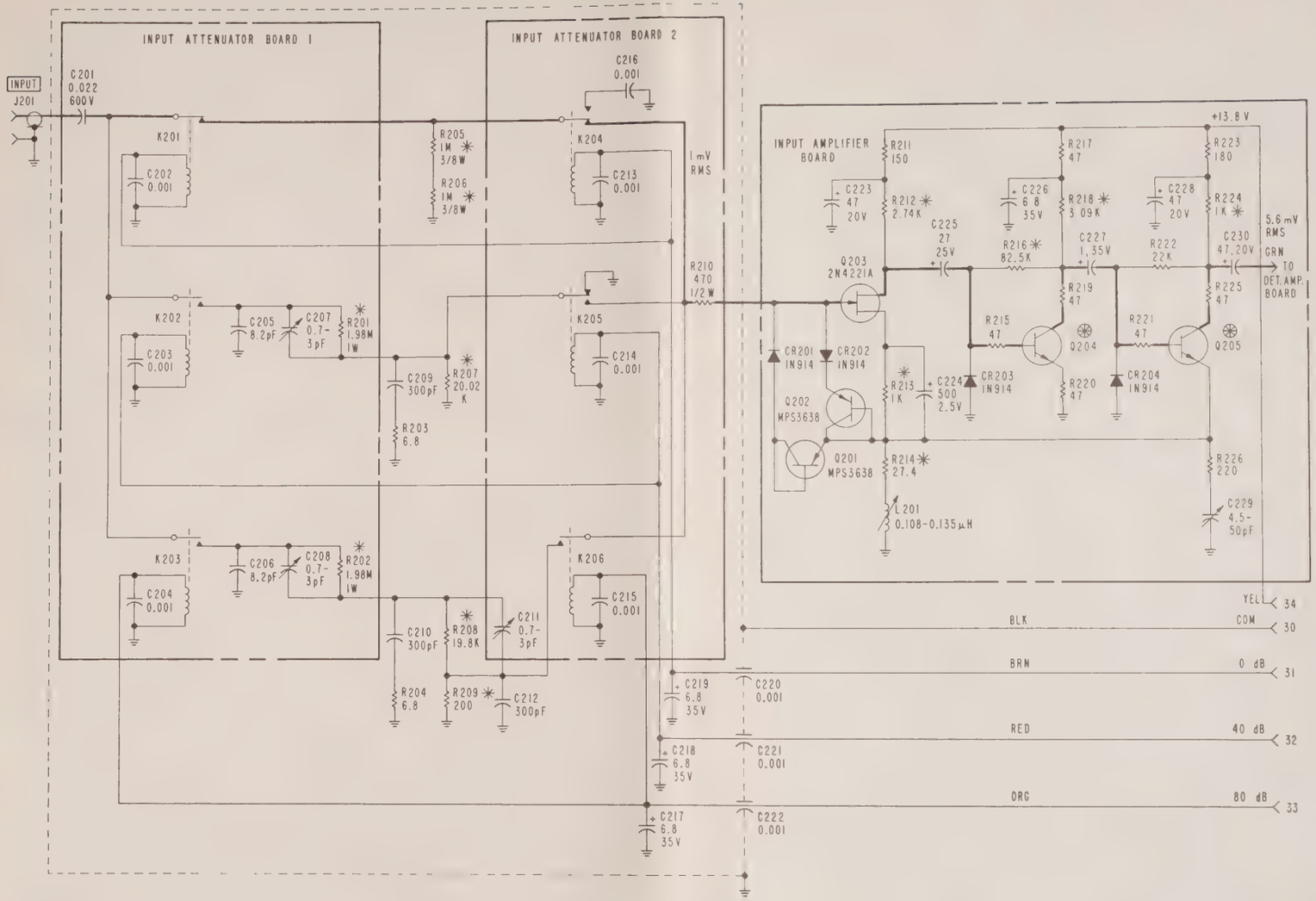
BOONTON ELECTRONICS

Model 234D
Schematic, Master Board
B81064/A (1 of 5)







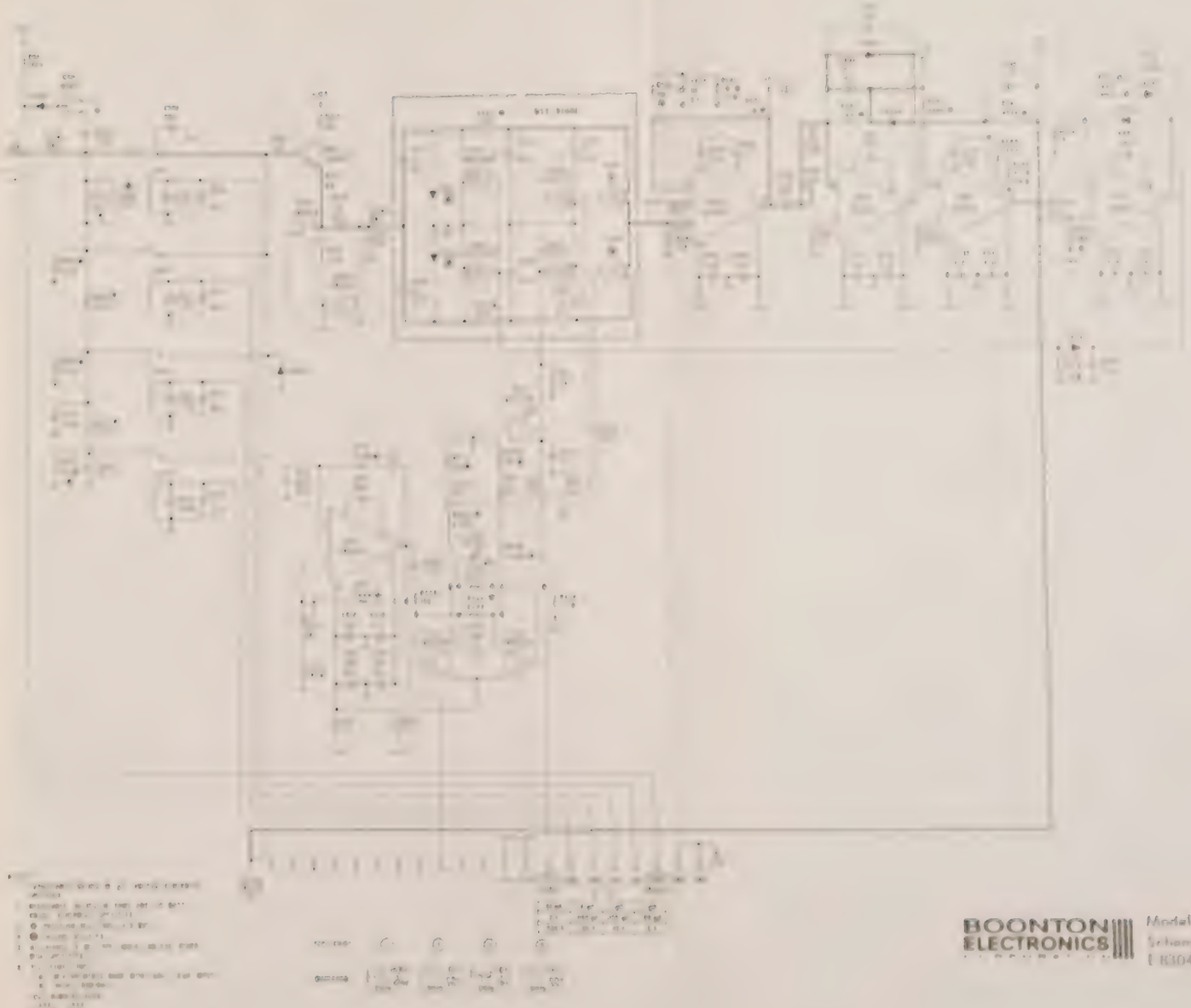


NOTES:

1. CAPACITANCE VALUES IN μF, UNLESS OTHERWISE SPECIFIED.
2. RESISTANCE VALUES IN OHMS AND 1/4 WATT, UNLESS OTHERWISE SPECIFIED.
3. ✳ PRECISION RESISTOR.
4. ⊛ FACTORY SELECTED.
5. LAST NUMBERS USED:
   R226 C230
6. ▭ EXTERNAL MARKINGS.
7. TEST CONDITIONS:
   ALL MEASUREMENTS MADE WITH 1 kHz 1mV INPUT. ALL VALUES NOMINAL.
8. ——— SIGNAL PATH.

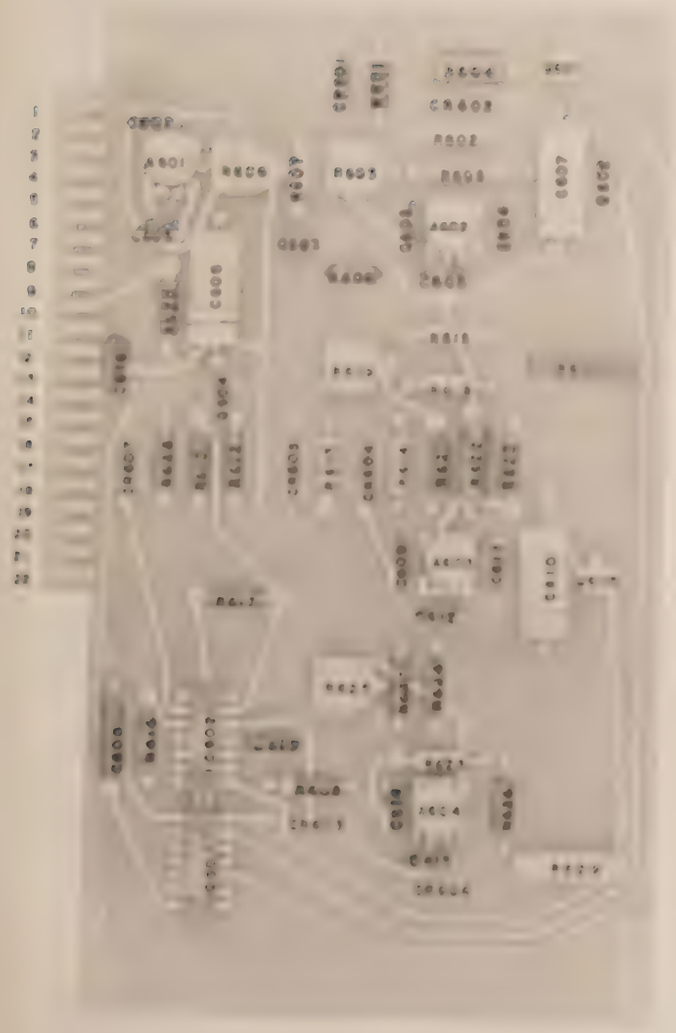
BOONTON ELECTRONICS CORPORATION

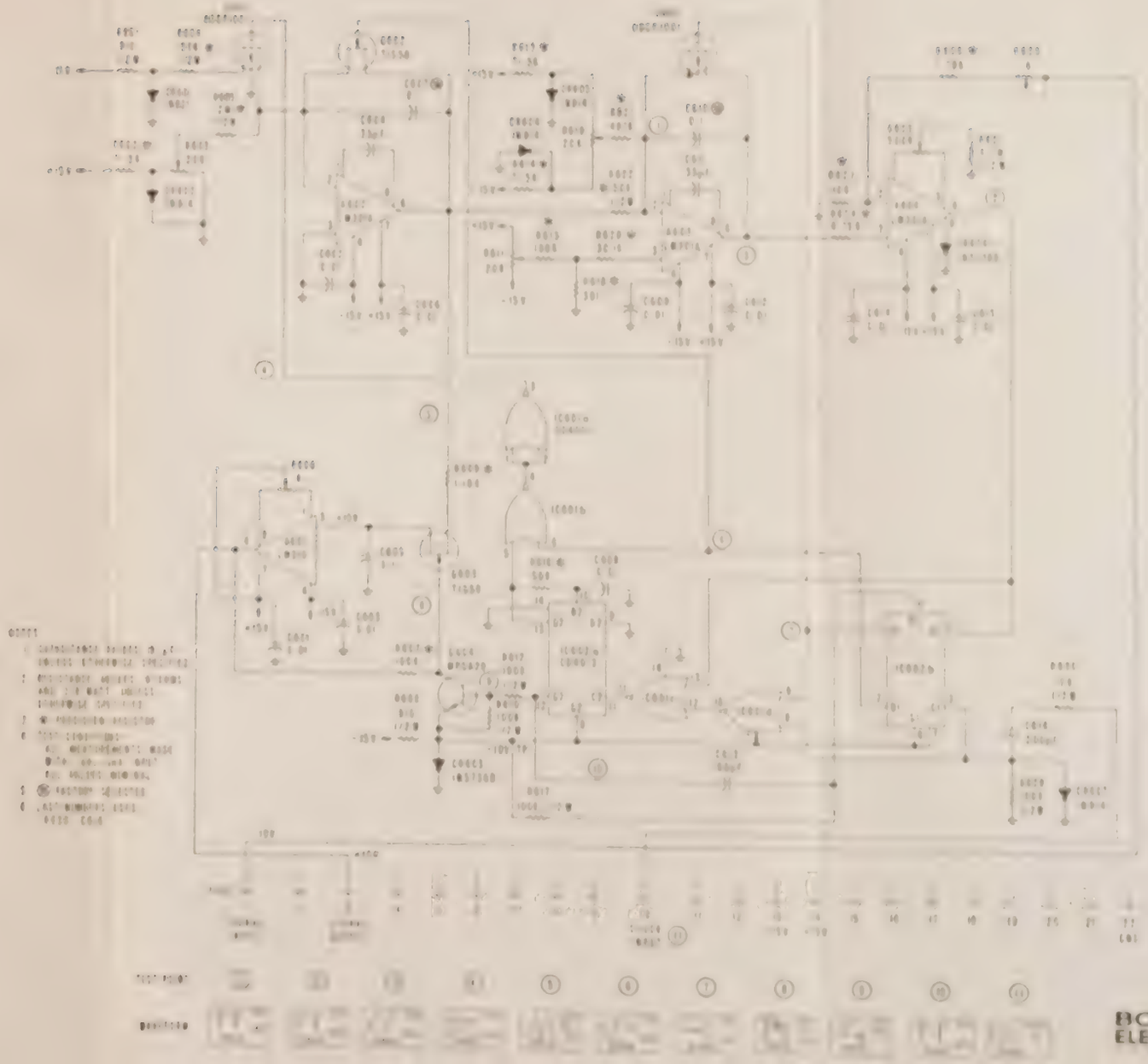
Model 93AD
Schematic, Input Att. Amp.
E:830457B (Sh. 2 of 5)



BOONTON ELECTRONICS

Model 1120A
Schematic, Detector Amp.
D-B10457C (Sh. 3 of 5)

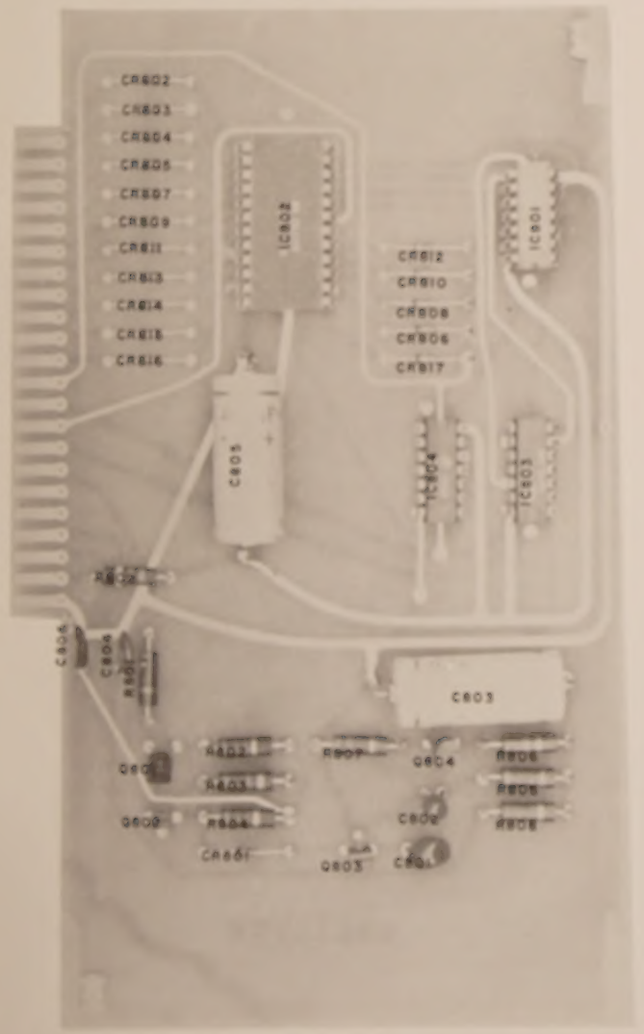


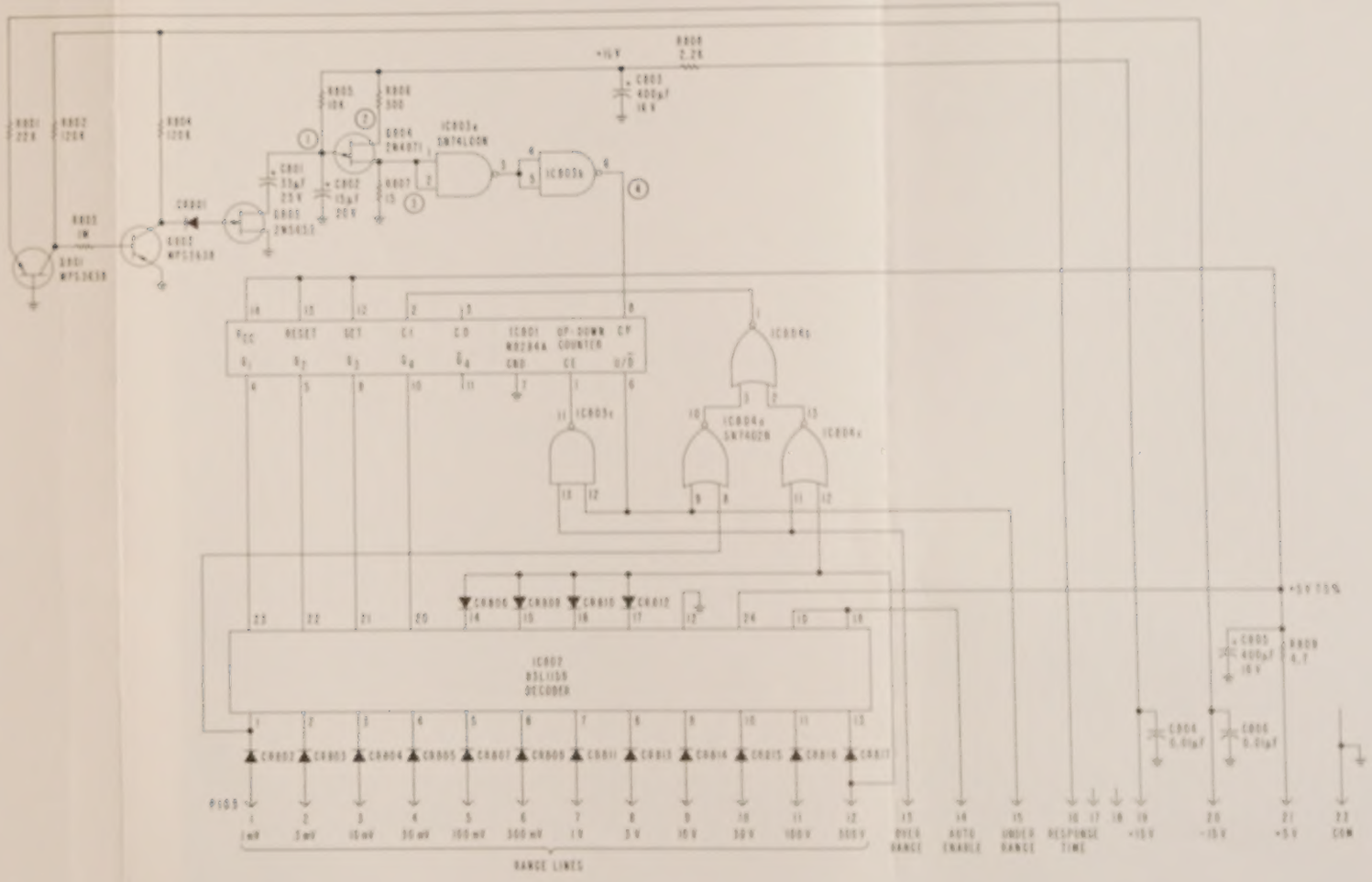


BOONTON ELECTRONICS

BOONTON ELECTRONICS

Model 91AD
Schematic, Digital Control





NOTES:
1. RESISTANCE VALUES IN OHMS AND 1/2 WATT, UNLESS OTHERWISE SPECIFIED.
2. ALL DIODES TO BE TYPE IN914, UNLESS OTHERWISE SPECIFIED.
3. TEST CONDITIONS:
   ALL MEASUREMENTS MADE WITH 1kHz, 1.0mV INPUT.
   ALL VALUES NOMINAL.
4. LAST NUMBERS USED:
   R809 C806 CR817

TEST POINT ① ② ③ ④

WAVEFORM

BOONTON ELECTRONICS CORPORATION

Model 93AD
Schematic, Autorange
D830548A

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